Sovereign Bail-Outs and Fiscal Rules in a Banking Union*

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Abstract

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Keywords: Sovereign Debt; Bail-out; Fiscal Federations; Fiscal Rules

JEL Classification Numbers: H63, H87, E62, F34.

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1 Introduction

At the beginning of the institutional building process of the European Monetary Union (EMU), fiscal rules on budget deficits were anchored solely to nominal constraints. Maastricht Treaty (1992) defined the so-called ‘3%-rule’, according to which member states must keep each year a ratio between nominal deficit and GDP not higher than 3%. One of the main rationales for imposing a cap on member states’ deficit is represented by the possibility – perceived by financial markets – that less ‘virtuous’ member states benefit from more ‘virtuous’ members’ financial help (bail-out) and, therefore, fail to internalize the negative externality they impose on other Union’s members (see, for instance, Chari and Kehoe (1998), Dixit and Lambertini (2001), Dixit (2001), and Tirole (2015)). This concern has grown with the increasing linkages produced by the integration of the EMU financial markets, such as the process of cross-border banking integration, and the increasing tendency of banks of core EMU countries to acquire significant holdings of sovereign bonds of other EMU members. During the 2010-2012 sovereign debt crisis, for example, the governments of core EMU countries came under pressure to relieve the sovereign debt burden of periphery countries due to the significant exposure of their own banking systems to those sovereigns. This was the case especially for French
and German banks which had accumulated sizeable holdings of government bonds of Greece, Portugal and
Italy (Brekenfelder and Schwaab, 2018; Altavilla et al. (2017); Guerrieri et al. (2013)).

As a consequence of the 2010-2012 sovereign debt crisis, the Fiscal Compact Treaty (2013) has modified
the set of fiscal constraints in the EMU by adding a new rule based on a ‘cyclically-adjusted’ deficit target.
The first questioning of cyclically-adjusted budget deficit as the most appropriate fiscal policy indicator
dates back to Blanchard (1990). More recently, several scholars have raised issues with the performance of
cyclically-adjusted fiscal rules as compared to those based on nominal targets (see, e.g., Debrun et al. (2008)
and Larch and Turrini (2009).\footnote{Other relevant studies include Petrova (2012), Carnot (2014), Corders et al. (2015), Kinda (2015), Andrle et al. (2015).} And, at the EMU level, the European Central Bank acknowledges that the
fiscal adjustment path dictated by the new cyclically-adjusted set of rules is performing poorly (European
Central Bank (2015)).

The main reason why the effectiveness of cyclically-adjusted fiscal rules might be questioned is that
it ultimately relies on the computation of each country’s potential output, from which – given the actual
observable output level – it follows the size of the output gap.\footnote{A country’s potential output is defined as the highest real output level – compatible with a stable inflation rate – that the
country can sustain in the long-run.} However, pinning down countries’ potential output is hard, and gives rise to controversies between the European Commission and member states’
governments. For instance, in April 2016, seven EMU governments asked the EU Commission for a revision
of the potential output estimation procedures, stressing that the estimation of the output performed by
international institutions such as the OECD and the IMF significantly differs from the EMU one.

In this paper, we argue that cyclically-adjusted fiscal rules (such as those currently adopted in the
EMU) are suboptimal in the presence of intra-union bail-out incentives and asymmetric information over
the member states’ potential output. Inspired by the experience of the 2010-2012 sovereign debt crisis, and
in the line of a growing literature on sovereign-banks linkages (e.g., Auraya et al. (2018); Gennaioli et al.
(2014); Lakdawala et al. (2018)), we model the bail-out incentive as resulting from the exposure of the banks
of a country in the union to the sovereign debt of other members of the union.

We construct a two-country model in which one country – the ‘core’ – has deep pockets and the other
country – the ‘periphery’ – seeks to finance public expenditures by borrowing from banks located in the
core. The periphery’s government is privately informed about the country’s potential output (and output
gap), which can be either high or low. The government spending multiplier increases with the magnitude of
the (negative) output gap. As it is standard in models of asymmetric information, absent bail-out, either a
signalling or a pooling equilibrium would emerge in the game played between the periphery and the outside
creditors (see for instance Innes (1991)). By diluting the difference in the probability of default between the
periphery with a high potential output and that with a low potential output, bail-out makes the periphery less
eager to signal its true cyclical position to the financial market.\(^3\) Absent any intervention by a supranational authority, in a *laissez-faire* environment with bail-out the periphery over-borrows from banks located in the core, thereby imposing an expected cost of bail-out on that country. We study the welfare implications of two possible types of interventions by a supranational authority (the union). The union can prevent excessive overborrowing by imposing a (*bunching*) constraint on the periphery’s borrowing level based on its own estimates of the member state’s output gap. Alternatively, it can design a (*separating*) mechanism in which a member state with a smaller (negative) output gap self-selects into its efficient level of borrowing upon receiving (ex post) a lump-sum transfer from the other country (the core). We characterize conditions under which the *separating* mechanism Pareto dominates the *bunching* fiscal rule. In particular, we show that, as the prior probability that the periphery is characterized by a high potential output increases, the relatively low bail-out costs and the efficiency gains generated by the *separating* mechanism make it Pareto-dominant with respect to the *bunching* rule. This result stems from the fact that, unlike the *separating* mechanism, the *bunching* constraint on borrowing becomes less stringent as the estimates on the periphery’s output gap become more optimistic. This, in turn, implies an increasing cost of bail-out for the core were the periphery to default.

These results can have insightful policy implications for the design of fiscal policies in federations. The framework can be broadly applied to federations characterized by limited information about the fiscal stance of their jurisdictions and by non-negligible financial linkages among the jurisdictions. Continuing with the application to the EMU case, provided EMU aims at implementing a cyclically-adjusted mechanism while eliciting member states’ private information, the mechanism proposed in this paper presents one major difference with respect to the current European fiscal framework. To avoid overborrowing when a member state is not far from its potential, the (relatively) low deficit required from a member state characterized by a (relatively) low potential output must come with an ex-post transfer to be received from the other members of the Union. Possibly, the transfer can be used to raise the member state’s potential output. This mechanism has two crucial features: (i) it comes from the ‘federal’ level, therefore it implies a degree of fiscal risk sharing within the Union, and (ii) it can be specifically targeted towards goals (possibly jointly determined between the nation state and the union) regarding a permanent increase of a member state’s production possibilities. Our analysis characterizes conditions under which, in the presence of asymmetric information and bail-out incentives, such a mechanism would Pareto dominate the current European fiscal framework and, hence, could be adopted under the unanimous voting scheme that is needed to reform EU treaties.

\[^3\]An analyses of bail-out at the international level can be found in Corsetti et al. (2006), Bolton and Jeanne (2011), and Tirole (2015).
Our framework is based on two main premises. First, national governments have better information than union-level decision-making bodies about their country's fiscal and cyclical stance. Second, the size of the government spending multiplier increases in the (negative) output gap.

Concerning the first premise, the presence of an asymmetric information problem between government layers has been extensively investigated in the public finance literature. Lockwood (1999), Bordignon et al. (2001), Cornes and Silva (2002), and Besfamille (2003) — among others — argue that local governments have a superior knowledge of macroeconomic conditions and/or structural parameters of the economy. Bottazzi and Manasse (2005) build a model in which the true state of the national business cycle is private information, and derive implications for the optimal (common) monetary policy in a monetary union. Following this strand of studies, we assume that member states are better informed about their potential output with respect to the union decision-making body.4 In particular, we study the interaction between this type of information asymmetry and bail-out among members of a union, and derive implications for the optimal fiscal policy.

Concerning our second premise, it is supported by contributions on both the theoretical and the empirical sides. From the theoretical viewpoint, Christiano et al. (2009) and Woodford (2010) note that the spending multiplier is higher during recessions because the economy is most likely to reach the zero lower bound on the nominal interest rate.5 In particular, the proportionality between slack capacity and output effects of the government spending stimulus comes from the fact that, because of the higher output gap, the government-spending-induced increase in output translates into a lower rise in inflation due to the flatter marginal cost curve which prevails under a great deal of excess capacity. This intuition is empirically confirmed and fairly robust to alternative estimation techniques. Auerbach and Gorodnichenko (2012a) estimate a quarterly data model (1947-2009) for the United States and find that the output effect of government spending is considerably larger during a recession than during an expansion. Auerbach and Gorodnichenko (2012b) and Batini et al. (2012) obtain similar results by looking at a larger sample of OECD countries. Baum et al. (2012) use output gap (rather than GDP growth) to better identify business cycle fluctuations (see also Harding and Pagan (2002)). They investigate six of the G7 economies from the 1970s to 2011 and find that in all the cases the magnitude of the multiplier is increasing with the negative output gap.

The remainder of the paper unfolds as follows. Section 2 lays out the model. We first solve the model under complete information and no bail-out (Section 3.1). We then insert both features and characterize the equilibrium in a decentralized (unregulated) setting (Section 3.2). Section 4 analyzes the optimal properties

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4For instance, member states’ potential output may be thought of as a function of the national government’s past (structural) investments, where the efficiency of past investments — e.g., the fraction of investments that is not spent in socially wasteful private perks — is national government’s private information.

5See also Manasse (2007).
of two alternative fiscal rules – a bunching and a separating mechanism – and provides a Pareto ranking of all the equilibria. Section 5 concludes and offers some policy implications. All the proofs are relegated to the Appendix. The Online Supplement briefly compares our model to the EMU current fiscal framework and discusses costs and benefits of targeting cyclically-adjusted variables.

2 The Model

We consider two countries $S_i$, for $i = 1, 2$. The government of each country finances public expenditures $I_i$ possibly resorting to taxation and to borrowing from competitive domestic and foreign banks.\(^6\) We analyze a simplified setting in which the government of country 1, the ‘core’, has deep pockets – i.e., it does not need to turn to financial markets to finance its expenditures – whereas the government of country 2, the ‘periphery’, finances expenditures by resorting to (primary) deficit $B \in [0, +\infty)$. The government of country 2 can borrow from banks of country 1. Given the focus of this paper, to simplify the exposition, we disregard the presence of banks of country 2.\(^7\) Banks of country 1 gather deposits from competitive home investors, hold government bonds and grant loans to home agents. For simplicity we abstract from foreign loans in our setting. Banks of country 1 are subject to a market or regulatory capital constraint which specifies that

$$E \geq \psi_L L$$

(1)

where $E$ is the banks’ equity capital, $L$ are loans, and $\psi_L > 1$ captures the capital requirement on loans. In turn, from the definition of bank capital,

$$E = R + C^0 + L^0 - D^0,$$

(2)

where $R$ is the repayment on outstanding government bonds held in country 2, $C^0$ is the amount of cash at the banks’ disposal, $L^0$ is the outstanding loan stock, and $D^0$ is the outstanding deposit stock, and where we take the triple $(C^0, L^0, D^0)$ as given (determined in an unmodelled past). $L^0$ can be interpreted as the level of $L$ that maximizes banks’ profits. As long as their capital constraint is not binding, core (country 1) banks are unrestricted in the amount of lending to agents in their own country. When the constraint (1) binds, instead, their loans are restricted to be equal to

$$L = \frac{R + C^0 + L^0 - D^0}{\psi_L},$$

(3)

\(^6\)In what follows, we use $S_i$ to refer to both country $i$ and the government of country $i$, for $i = 1, 2$. A distinction between a country and its government is explicitly made when necessary.

\(^7\)Adding banks of country 2 which hold a share of country 2’s sovereign bonds would not qualitatively affect our main results.
which is increasing in the repayment $R$ of country 2’s government.

As we intend to mimic a short-run macroeconomic framework, we assume that deficit spending $B$ has real effects, i.e., it has a positive effect on income level $Y_2$ because of, for instance, nominal rigidities. Further, to capture linkages between the banking sector and the real sector, we also allow the output of a country to depend on the amount of loans extended by banks. In particular, $S_1$ produces an end-of-period output $Y_1 = Y_1(L)$. A broad literature endogenizes these linkages, and in our setting we represent them in reduced form by positing that output is also a function of bank loans.

Unlike $Y_1$, $S_2$’s end-of-period output is stochastic, with $Y_2 = Y_2(\theta, B, \mu)$, where $\mu$ is a random variable, and where $\theta \in \{\bar{\theta}, \theta\}$ represents $S_2$’s cyclical position with respect to its potential output, with $\bar{\theta} > \theta$. More specifically, when $\theta = \bar{\theta}$ (respectively, $\theta = \underline{\theta}$), the absolute value of $S_2$’s output gap is large (small): given some (unmodelled) initial conditions on the output produced before the beginning of the (accounting) period, a large (respectively small) output gap implies a large (respectively small) potential output. $\theta$ is $S_2$’s private information. Banks of country 1 attach a probability $\alpha$ to $\theta = \bar{\theta}$, and $(1 - \alpha)$ to $\theta = \underline{\theta}$. Because we analyze a short-run macroeconomic framework, we assume that potential output is exogenous and unaffected by investments.

As in Innes (1991), given $(\theta, B)$, the random variable $\mu$ generates a probability density function $f( Y_2 | \theta, B)$ and a distribution function $F( Y_2 | \theta, B)$ for $Y_2$. We assume $f(\cdot)$ is continuously differentiable on $[y(\theta), K(\theta, B)]$, where $K(\cdot) > y(\cdot)$ whenever $B > 0$. Also, following our discussion in Section 1, we assume that a larger output gap $\theta$ and a higher investment financed through deficit $B$ generate better output distributions in the sense of first-order stochastic dominance. Specifically

$$F_{\theta}(Y_2) < 0, \quad F_{B}(Y_2) < 0, \quad \text{and} \quad F_{\theta B}(Y_2) < 0, \quad \forall Y_2 \in [y(\theta), K(\theta, B)],$$

(4)

where subscripts denote partial derivatives. The last inequality in (4) implies that a larger output gap is associated with a higher multiplier of government spending. We finally assume that the expected output $E[Y_2 | \theta, B]$ is increasing and concave in $B$, and that the Inada conditions hold.

Financial Market and Bail-out. The government of $S_2$ signs a contract with perfectly competitive and risk neutral banks of country 1. We take the return on a risk-free bond to be equal to zero. The contract

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8In the following, we make use of the framework developed in Innes (1991), and adapt it to the case of sovereign borrowing and bail-out.

9The output $Y_2$ is not function of the loans of banks of country 2 because we have assumed away their presence in the model.

10As argued at the end of Section 2, this allows our model to be based equivalently either on the asymmetry about potential output level or the size of government spending multiplier.

11As we disregard long-run considerations, the marginal utility of income is always increasing, so that national governments are not satiated with the closing of output gap because of political short-termism (see, for instance, Dixit and Lambertini (2001)).
consists of the amount $B$ borrowed by the government of $S_2$ and a return for banks $R(Y_2, x)$ to be paid at the end of the period. This return depends on (i) the realization of output $Y_2$, and (ii) any 'bail-out' transfer $x \geq 0$ made by $S_1$ to $S_2$. More specifically, given a debt contract, we have

$$R(Y_2, x, \theta) = \min \{Y_2 + x, z(\theta)\}, \text{ for } \theta \in \{\underline{\theta}, \bar{\theta}\},$$

where $z$ is a promised loan repayment, possibly contingent on $\theta$.

Foreign banks’ holding of government bonds gives rise to cross-country spillovers and can generate an incentive for the government of a foreign country to bail the borrowing country out. In our framework, $S_1$’s incentive to bail $S_2$ out stems from $S_1$’s domestic banks holding $B$ among their assets. In the presence of capital requirements for banks, bail-out can prevent domestic banks from cutting credit to $S_1$’s domestic agents (see (1) and (2)). As we formally show below, bail-out, however, generates further potential inefficiencies.

**Ex-ante Contracting.** We consider the presence of a central authority $P$ whose objective is to maximize the (unweighted) joint utility of $S_1$ and $S_2$ (see below). $P$ has no budget. $S_1$ and $S_2$ delegate $P$ the authority to design a contract — possibly contingent on $\theta$ — consisting of the amount $B$ borrowed by the government of $S_2$ and a (ex-post) transfer $t \in \mathbb{R}^+$ from $S_1$ to $S_2$. In particular, $B$ is borrowed in the financial market at the beginning of the period, whereas the transfer $t$ is cleared at the end of the period, i.e., after the realization of $Y_2$ is observed by all the players (see the timing below). By restricting $t$ to take positive values, we effectively introduce a limited liability constraint for $S_2$. We take the amount $B$ specified in the mechanism offered by $P$ to be a fixed borrowing level. We assume $P$ can enforce the limits imposed on $B$.

The mechanism $(t(\theta), B(\theta))$, for $\theta \in \{\underline{\theta}, \bar{\theta}\}$, proposed by $P$ can be either a *bunching* mechanism — i.e., $t(\underline{\theta}) = t(\bar{\theta}) = 0$ and $B(\underline{\theta}) = B(\bar{\theta}) = B^*$ — or a *separating* mechanism — i.e., $\{(t(\underline{\theta}), B(\underline{\theta})), (t(\bar{\theta}), B(\bar{\theta}))\}$, with $t(\underline{\theta}) \neq t(\bar{\theta})$ and $B(\underline{\theta}) \neq B(\bar{\theta})$. We also define a ‘decentralized’ (laissez-faire) solution as one in which $t(\theta) = t(\bar{\theta}) = 0$ and $B(\theta) = B(\bar{\theta})$. Which of these solutions is implemented will finally depend on

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13In principle, one could think that $S_1$ might also intervene by directly supporting its banks (e.g., through recapitalization). There are however economic and political costs of such interventions (and in the EMU restrictions on their implementation). Further, our model may also capture a richer setting with multiple core countries in which one core country bailouts the periphery to prevent banks in all core countries from contracting credit and triggering a downturn. These aspects are outside the focus of our analysis.

14Within the European Monetary Union, for instance, the attempt to overcome this issue by inserting an explicit ‘no-bail-out clause’ in the Maastricht Treaty (art. 125 of the Lisbon Treaty) has proved quite ineffective as the sovereign debt crisis in the Eurozone displayed its effects. For a discussion of the free-rider problem within a monetary union — in which member states borrow in a common currency — see Buiter et al. (1993), Beetsma and Uhlig (1999), Von Hagen and Eichengreen (1996), Lane (2012).

15Assuming $t \geq 0$ does not affect our Pareto analysis in Section 4.3, because $t$ represents a (costless) transfer from $S_1$ to $S_2$.

16Alternatively, $B$ could be modeled as an upper bound on $S_2$’s borrowing. This latter modelling choice would better capture the case of the European Monetary Union fiscal rules. None of our results are qualitatively affected by this choice.
the agreement reached between $S_1$ and $S_2$. In this paper, we remain agnostic about the exact process by which countries’ preferences are aggregated, and we instead focus on the Pareto properties of the different solutions at countries’ disposal. The Pareto criterion can be thought, for example, as reflecting the unanimous voting rule that is needed to reform EU treaties (i.e., to choose among the different solutions in our model economy).

In the following, we denote $(t(\theta), B(\theta))$ and $(\bar{t}(\theta), \bar{B}(\theta))$ by $(t, B)$ and $(\bar{t}, \bar{B})$, respectively. Similarly, we define $z(\theta)$ and $z(\bar{\theta})$ by $z$ and $\bar{z}$, respectively.

**Utility Functions.** $S_1$’s (ex-ante) utility function is:

$$U_1(L, B, \theta, x) = Y_1(L) +$$

$$-\alpha \left[ \tilde{t} + \int \min \{ (z - Y_2, x) f(\theta, B) \} dY_2 \right] - (1 - \alpha) \left[ \tilde{t} + \int \min \{ (z - Y_2, x) f(\theta, B) \} dY_2 \right]$$

where the two integrals on the right-hand-side (RHS) of (6) represent the expected cost to $S_1$ of bailing $S_2$ out.

$S_2$’s utility function is:

$$U_2(B, \theta) = t(\theta) + \int_{\max\{y(\theta), z(\theta)\}}^{K(\theta, B)} [(Y_2 - z(\theta)) f(Y_2 | \theta, B)] dY_2,$$

for $\theta \in \{\theta, \bar{\theta}\}$.

$P$’s utility function reads:

$$V(L, B, \theta) = U_1(L) + [\alpha U_2(B, \theta) + (1 - \alpha) U_2(B, \theta)].$$

**Simplifying Assumptions.** We assume (A1):

$$\frac{\partial Y_1(L)}{\partial L} \geq \psi_L.$$
As we clarify below, A1 makes $S_1$ eager to fully bail $S_2$ out when needed. We also impose (A2):

$$0 = y(\bar{\theta}) < B^*(\bar{\theta}) \leq y(\bar{\theta}),$$

(10)

where the $\bar{\theta}$-type’s optimal borrowing level $B^*(\bar{\theta})$ is defined below. A2 simplifies our framework by making the $\bar{\theta}$-type risk-free when choosing its optimal investment level. Bail-out is therefore relevant only for $\theta = \bar{\theta}$.

**Timing.** We analyze a one-period game composed of six stages.

**Stage 0:** Nature draws $\theta$, and this is revealed to $S_2$.

**Stage 1:** $P$ designs a mechanism $\{t(\theta), B(\theta)\}$, for $\theta \in \{\theta, \bar{\theta}\}$.

**Stage 2:** After observing the mechanism offered by $P$, $S_2$ announces an investment level $B$ and a repayment $z$; lenders (country 1’s banks) decide whether to accept $S_2$’s offer.

**Stage 3:** $Y_2$ realizes and is publicly observed.

**Stage 4:** If $Y_2 < z$, $S_1$ decides whether to bail $S_2$ out by an amount $x$. $S_2$ repays lenders. The transfer $t$ is also made.

**Stage 5:** Banks of country 1 extend loans $L$ to country 1’s private sector and $Y_1(L)$ realizes.

Our solution concept is Perfect Bayesian Equilibrium (PBE). Recall that our goal is to study the Pareto properties of the different solutions – *bunching*, *separating* and *laissez-faire* – at $S_1$ and $S_2$’s disposal. To this end, when we consider the *bunching* and *separating* solutions, $P$’s role in Stage 1 only consists of selecting the contract that maximizes the joint utility of $S_1$ and $S_2$ within any of these two mechanisms. To rephrase it, $P$ can only choose its preferred *bunching* and *separating* mechanism, but it cannot choose between the *bunching* mechanism, the *separating* mechanism, and the *laissez-faire* solution.\(^{17}\)

In what follows, we first characterize the optimal solution to $S_2$’s investment problem absent any intervention by $P$ (Section 3): Section 3.1 presents the analysis of $S_2$’s investment choice in the absence of both asymmetric information and bail-out. In Section 3.2, we add both features and characterize a decentralized (*laissez-faire*) equilibrium. Section 4 studies the equilibria under an optimal (i) separating mechanism and (ii) bunching rule, and study the Pareto ranking of all these equilibria.

\(^{17}\)Hence, when using the wording *separating* (*bunching*, resp.) equilibrium, we refer to the equilibrium of the game in which $P$ is restricted to propose a *separating* (*bunching*, resp.) mechanism.
3 Borrowing in a Laissez-faire Environment

In this section, we study the case in which \( P \) is absent. Formally, we drop Stage 1 from the timing of our game.

3.1 A Benchmark: Symmetric Information absent Bail-out

Suppose \( \theta \) is perfectly observable by all the parties and bail-out is not allowed (i.e., \( x = 0 \)). Because banks are competitive, we expect \( S_2 \) to appropriate the entire surplus generated by government spending. More specifically, \( S_2 \) solves:

\[
\max_{\{B\}} E\left[ Y_2 - \min\{Y_2, z(\theta)\} \mid \theta, B\right],
\]
\[
\text{s.t. } E\left[ \min\{Y_2, z(\theta)\} \mid \theta, B\right] = B,
\]

where the constraint represents banks’ zero-profit condition. From (11), \( S_2 \) solves:

\[
\max_{\{B\}} \int_{y(\theta)}^{K(\theta, B)} Y_2 f(Y_2 \mid \theta, B) dY_2 - B,
\]

which gives us the symmetric information optimal borrowing level \( B^* (\theta) \), for \( \theta \in \{\bar{\theta}, \bar{\theta}\} \) (see also Figure 1).

From (4), because \( F_{bs}(Y) < 0 \), we have \( B^* (\bar{\theta}) > B^* (\bar{\theta}) \), where \( B^* (\cdot) \) denotes the solution to (12). Absent any information asymmetry and bail-out mechanism, optimality requires the \( \bar{\theta} \)-type to borrow more than the \( \bar{\theta} \)-type, because the former has a higher spending multiplier.

3.2 Asymmetric Information and Bail-out

Consider now the case in which \( \theta \) is \( S_2 \)'s private information. When banks of country 1 lend to \( S_2 \), we allow for \( S_1 \) to bail \( S_2 \) out in the event the realized output \( Y_2 \) falls short of the promised repayment.

3.2.1 Bail-out Analysis

We proceed by backward induction. Suppose \( S_2 \) borrows \( B \) from banks and promises to repay \( z \).\(^{18}\) Suppose also that, in Stage 3 of our game, \( Y_2 < z \) realizes, which implies \( R < z \), unless \( S_1 \) bails out \( S_2 \) — and, de facto, its home banks — by contributing \( x > 0 \) in Stage 4. The following constrained maximization problem

\(^{18}\text{Banks can finance } B \text{ by employing part of their cash } C^0.\)
solved by $P$ in Stage 5—determines the optimal amount of $x$:

$$
\max_{\{x\}} \{ x \}
\begin{align*}
\max Y_1 (L) - x \\
\text{s.t. } L &\leq \frac{(C^0 - B) + R(x) + L^0 - D^0}{\psi_L}, \\
x &\leq \max\{ z - Y_2, 0 \}.
\end{align*}
$$

The first constraint in (13) anticipates that the level of loans granted by banks does not violate banks’ capital constraint (1) in Stage 5. The second constraint simply states that the amount $x$ chosen by $S_1$ does not exceed the difference between $S_2$’s promised repayment $z$ and the output $Y_2$ it produces. We take banks’ optimal choice of loans $L^*$ in Stage 5 as exogenous, and we assume (A3):

$$
L^* \geq \frac{(C^0 - B) + z + L^0 - D^0}{\psi_L}.
$$

According to (A3), the capital constraint (1) binds in Stage 5. From A1 and A3 it is then straightforward to show that $S_1$ has an incentive to fully bail $S_2$ out—i.e., $x^* = z - Y_2$—as the marginal benefit of transferring an extra dollar to $S_2$ (equal to $\frac{1}{\psi_L} \frac{\partial Y_1(L)}{\partial L}$) exceeds its marginal cost (equal to 1), for any $L \leq L^*$. In our setting, the more stringent the capital constraint—that is, the higher $\psi_L$—the less eager is $S_1$ to bail its home banks out. This stems from the fact that from (3), the higher $\psi_L$, the lower is the (positive) effect of bail-out on new loans ($L$).

In what follows, we define $U_1^* = Y_1(L)$ when $R(x) = z$.

3.2.2 Borrowing Analysis

The pair $\{B^* (\theta), B^* (\bar{\theta})\}$ maximizes $P$’s utility in (8). However, because of (i) asymmetric information on $\theta$ and (ii) potential bail-out of $S_2$ by $S_1$, the efficient investment may not be achieved in a decentralized setting, i.e., absent $P$’s intervention.

Following Innes (1991), we define $S_2$’s indifference curves and lenders’ offer curves (see also Figure 1). Let us disregard the mechanism offered by $P$ (i.e., we set $t(\theta) = 0$) and consider the case in which bail-out is absent (i.e., $x = 0$). $S_2$’s indifference curve $IC(\theta)$ is the set of points on the $(B, z)$ space that yield a common utility level to $S_2$:

$$
U_2 (B, z, \theta) = \int_{\max\{y(\theta), z\}}^{K(\theta, B)} (Y_2 - z) f(Y_2 \mid \theta, B) dY_2 = \tilde{U}(\theta),
$$

(15)
for $\theta \in \{\theta, \bar{\theta}\}$.

The lenders’ offer curve is the set of points on the $(B, z)$ space that yield an expected profit equal to zero. It is useful to distinguish the separating offer curves from the pooling one. For expositional purposes, we first define the offer curves for the case in which bail-out is absent, and we then discuss how they are affected by bail-out. Absent bail-out, the separating offer curve $OC(\theta)$ is given by:

$$R(B, z, \theta) = E[Y_2 | \theta, B] - \left[\int_{\max\{y(\theta), z\}}^{K(\theta, B)} (Y_2 - z) f(Y_2 | \theta, B) dY_2\right] - B = 0,$$

for $\theta \in \{\theta, \bar{\theta}\}$. $OC(\bar{\theta})$ lies on the 45$^\circ$ line on the $(B, z)$ space for values of $B \leq y(\bar{\theta})$. Because $y(\bar{\theta}) \geq B^* (\bar{\theta})$ from A2, we can anticipate that this is the case of interest in this paper.

The pooling offer curve $OC^p$ is given by:

$$\alpha R(B, z, \bar{\theta}) + (1 - \alpha) R(B, z, \theta) = 0. \quad (17)$$

Let us re-introduce bail-out. Bail-out affects both the separating and the pooling offer curves through the loan repayment $z$ (from (5)). As we discuss above, from A2, bail-out has no effect on $OC(\bar{\theta})$, for $B \leq y(\bar{\theta})$. Therefore, in our simplified setting, bail-out affects only $OC(\bar{\theta})$. From A1 and A3, because banks expect $S_1$ to fully bail them out in case $Y_2 < z$, the offer curve in (16) lies on the 45$^\circ$ line for any value of $\theta$. As a consequence, (16) and (17) coincide.

As it is standard in models with asymmetric information, we impose that $S_2$ has steeper indifference curves when characterized by a large output gap ($\bar{\theta}$–type) rather than a small output gap ($\theta$–type):

$$\frac{dz}{dB} \Big| \bar{\theta} > \frac{\partial U_2(\theta, \cdot)}{\partial B} \Big| \bar{\theta} > \frac{\partial U_2(\theta, \cdot)}{\partial z} \Big| \bar{\theta} \Rightarrow \frac{dz}{dB} \Big| \bar{\theta}, \quad (18)$$

where the indifference curve is upward sloping because:

$$\frac{\partial U_2(\theta, \cdot)}{\partial B} = -\frac{K(\theta, B)}{z} \int \frac{\partial F(Y_2 | \theta, B)}{\partial B} dY_2 > 0, \quad (19)$$

$$\frac{\partial U_2(\theta, \cdot)}{\partial z} = -(1 - F(z | \theta, B)) < 0, \quad (20)$$

More specifically, the offer curve in [16] includes an extra-term equal to the expected bail-out + i.e., $E[\min\{Y_2 + x, z\}]$ - conditional on $Y_2 < z$. A1 ensures that $Y_2 + x < z$ does not occur, which implies $z(x) = B$. 

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Figure 1: Equilibria under (i) Complete Information–No Bail-out and (ii) Asymmetric Information–Bail-out.

for \( \theta \in \{ \theta, \bar{\theta} \} \). Finally, the lenders’ offer curves are upward sloping:

\[
\frac{dz}{dB} \bigg|_{R(\theta) = 0} \geq 1, \quad \text{for } \theta \in \{ \theta, \bar{\theta} \},
\]

where, absent bail-out, the slope of the offer curve is decreasing in \( \theta \).

Figure 1 illustrates the equilibrium pairs \((B(\theta), z(\theta))\), for \( \theta \in \{ \theta, \bar{\theta} \} \), that arise in (i) a symmetric information setting absent bail-out and (ii) an asymmetric information setting in the presence of bail-out.\(^\text{20}\)

The offer curves \(OC^\theta\) and \(OC(\theta)\), for \( \theta \in \{ \theta, \bar{\theta} \} \), are depicted for the case in which bail-out is absent. In the presence of bail-out, there is a unique offer curve given by \(OC(\bar{\theta})\). Indifference curves are also depicted (in blue for the \( \theta \)–type and in red for the \( \bar{\theta} \)–type); higher levels of utility correspond to indifference curves moving southward. The ‘complete information allocations’ are represented by the pair \(\{E^* (\theta), E^* (\bar{\theta})\}\), where the indifference curves for each type are tangent to the corresponding offer curves.

We denote by a superscript LF (for laissez-faire) \( S_2 \)'s optimal borrowing in the presence of bail-out and asymmetric information.

**Proposition 1.** In the presence of bail-out and asymmetric information, given \(A1-A2-A3\), \( S_2 \) does not signal its type to the financial market. The \( \bar{\theta} \)–type borrows optimally, i.e., \( B(\bar{\theta}) = B^* (\bar{\theta}) \), whereas the \( \theta \)–type overborrows from banks of country 1, i.e., \( B(\theta) = B^{LF} (\theta) > B^* (\theta) \), where \( B^{LF} (\theta) < B^* (\bar{\theta}) \).

\(^\text{20}\)All Figures depict the case of linear offer curves.
The pair \( \{ E^{LF}(\theta), E^*(\bar{\theta}) \} \) in Figure 1 represents the decentralized equilibrium – that is, the equilibrium absent P intervention – under asymmetric information and in the presence of bail-out. The inefficient over-investment by the \( \bar{\theta} \)-type is caused by the potential bail-out of \( S_2 \) by \( S_1 \). Because bail-out makes different types of \( S_2 \) identical, neither banks have an incentive to offer contracts to separate the types of \( S_2 \), nor \( S_2 \) has an incentive to signal its type by, for instance, overborrowing when \( \theta = \bar{\theta} \). As a result, both sides of the debt contract do not have incentives to discriminate among types, and the member state with a low potential output issues debt in excess.

Let \( U^{LF}_1(\alpha) \) denote \( S_1 \)'s expected utility when \( \{ E^{LF}(\theta), E^*(\bar{\theta}) \} \) occurs. We also define \( B^{LF} = B^{LF}(\theta, x) \).

**Lemma 1.** In the presence of bail-out and asymmetric information, \( S_1 \)'s expected utility under the laissez-faire regime is

\[
U^{LF}_1(\alpha) = U^*_1 - (1 - \alpha) \int_0^{B^{LF}} \left( B^{LF} - Y_2 \right) f \left( Y_2 \mid \theta, B^{LF} \right) dY_2, \tag{22}
\]

where \( U^{LF}_1(\alpha) \) is increasing in \( \alpha \).

**Proof.** See the Appendix.

To summarize, in our setting, in the presence of asymmetric information and bail-out (i) costly signalling by \( S_2 \) does not occur, (ii) the type of \( S_2 \) characterized by a low potential output \( \theta \) inefficiently overborrows on the market, and (iii) a higher prior probability \( \alpha \) that \( S_2 \) has a high potential output \( \bar{\theta} \) leads to a higher expected welfare for \( S_1 \).

## 4 Fiscal Rules

From \( P \)'s viewpoint, bail-out causes inefficient overborrowing by the \( \bar{\theta} \)-type of \( S_2 \). \( P \)'s goal is to induce efficient borrowing. This task is complicated by the presence of asymmetric information.

We first investigate the possibility for \( P \) to build a separating mechanism \( \{ (t, B), (\bar{t}, \bar{B}) \} \) that implements the efficient level of borrowing for both types of \( S_2 \) – that is \( \bar{B} = B^*(\theta) \) and \( B = B^*(\bar{\theta}) \).\(^{23}\) Provided such

\(^{21}\)Compared to Innes (1991), Figure 1 depicts the case in which, absent bail-out, asymmetric information would call for the \( \bar{\theta} \)-type to over-invest to signal to lenders the higher value of its multiplier of government spending with respect to that of the \( \theta \)-type.

\(^{22}\)Our ‘no-signalling’ result in Proposition 1 hinges on bail-out from \( S_1 \) to make \( \bar{\theta} \)-type identical to \( \bar{\theta} \)-type [see A1 and A3]. More generally, bail-out [at least] partially dilutes the difference between types of borrowers: Hence, by reducing cross-subsidization, bail-out reduces the incentives for signalling.

\(^{23}\)The revelation principle applies. Hence, we focus on direct revelation mechanisms.
a separating mechanism exists, it maximizes $P$’s utility in (8). It may not Pareto dominate the \textit{laissez-faire} solution and/or an alternative \textit{bunching} mechanism though. In Section 4.2, we solve for $P$’s optimal \textit{bunching} mechanism, in which $P$ sets a rule on $S_2$’s borrowing independent of its type $\theta$. We finally study the conditions under which the \textit{separating} mechanism Pareto dominates the \textit{bunching} mechanism and the \textit{laissez-faire} solution.

### 4.1 Separating Mechanism

In a separating mechanism, $S_2$’s Incentive Compatibility Constraints ($IC_0$) are:

\[
\bar{t} + \int_{z(B, x)}^{K(\theta, B)} (Y_2 - z(B, x)) f(Y_2 | \theta, B) dY_2 \geq \bar{t} + \int_{z(B, x)}^{K(\bar{\theta}, B)} (Y_2 - z(B, x)) f(Y_2 | \bar{\theta}, B) dY_2, \tag{23}
\]

\[
\bar{t} + \int_{y(\bar{\theta})}^{K(\bar{\theta}, B)} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, B) dY_2 \geq \bar{t} + \int_{y(\bar{\theta})}^{K(\bar{\theta}, B)} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, B) dY_2, \tag{24}
\]

for $\theta = \bar{\theta}$ and $\theta = \bar{\theta}$ respectively, with $z(B, x) = B$ in (23), for $B \in \{B, \bar{B}\}$ (from A1, A2 and A3).

**Lemma 2.** $P$ can implement efficient borrowing $(B, \bar{B})$ by setting:

\[
\bar{t}^* = \max \left[ \int_{B}^{K(\bar{\theta}, B)} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, B) dY_2 - \int_{B}^{K(\bar{\theta}, B)} (Y_2 - B) f(Y_2 | \bar{\theta}, B) dY_2, 0 \right], \tag{25}
\]

\[
\bar{t}^* = 0. \tag{26}
\]

**Proof.** See the Appendix.

Anticipating the Pareto analysis we perform in the following section, we derive the transfers set by $P$ to implement a separating mechanism in which both types of $S_2$ borrow efficiently and obtain a higher utility than under the \textit{laissez-faire} regime.
Lemma 3. When compared to the laissez-faire regime, $P$ can implement efficient borrowing $(B, \bar{B})$ by setting:

$$t^s = \int_{B^{LP}} (Y_2 - B^{LP}) f (Y_2 | \theta, B^{LP}) \, dY_2 - \int_{B} (Y_2 - B) f (Y_2 | \theta, B) \, dY_2 > 0,$$

(27)

$$\bar{t}^s = 0.$$  \hspace{1cm} (28)

Proof. See the Appendix. \hfill $\square$

The pair of points $\{E''(\bar{\theta}), E^*(\hat{\theta})\}$ in Figure 2 denotes $P$’s separating mechanism as described in Lemma 3. Figure 2 also shows the optimal borrowing under symmetric information (and no bail-out) and the laissez-faire solution.

Both types of $S_2$ are made indifferent between the laissez-faire solution and the mechanism proposed by $P$. In order to induce the $\theta$-type not to overborrow, $P$ must promise it a lump-sum transfer $t$ at least equal to its expected utility loss.
4.2 Bunching Mechanism

In the presence of asymmetric information and bail-out, an alternative solution to the separating mechanism constructed above is represented by a bunching mechanism. More specifically, $P$ can set a unique level $B^g$ to act as a constraint on $S_2$'s borrowing independently of its type $\theta$.

To determine the optimal bunching borrowing level, $P$ solves:

$$\max_{\{B\}} \left\{ U_1 (L, B, \theta, x) + \alpha U_2 (B, x, \theta) + (1 - \alpha) U_2 (B, x, \bar{\theta}) \right\}$$

subject to

$$\alpha E \left[ R (Y_2, x, \bar{\theta}) \right] + (1 - \alpha) E \left[ R (Y_2, x, \theta) \right] = B.$$  

Given A1-A3 and anticipating full bail-out, from (6) and (7), $P$'s optimal choice of $B$ is:

$$B^B (\alpha) = \arg \max_{\{B\}} \left\{ \int_{\theta} (Y_2 - B) f (Y_2 | \theta, B) dY_2 \right\} +$$

$$+ (1 - \alpha) \int_{B} (Y_2 - B) f (Y_2 | \theta, B) dY_2 -$$

$$- \int_{0} (B - Y_2) f (Y_2 | \theta, B) dY_2,$$

where bail-out implies $z (\theta) = B$, for all $\theta \in \{\theta, \bar{\theta}\}$. From (11), we have that:

$$B^B (\alpha) = \alpha B + (1 - \alpha) B.$$  

In Figure 3, $E^B$ illustrates the optimal bunching borrowing. Because of bail-out, $E^B$ lays on $OC (\bar{\theta})$, in between $E^* (\theta)$ and $E^* (\bar{\theta})$: the higher $\alpha$ is, the closer is $E^B$ to $E^* (\bar{\theta})$.

4.3 Pareto Analysis

We perform a Pareto analysis of the different solutions presented in the previous subsections. More specifically, we compare the following outcomes in terms of their welfare implications for all the players involved, i.e., $S_1$ and both the $\theta$–type and the $\bar{\theta}$–type of $S_2$:

1. $\{E^{LF} (\theta), E^* (\bar{\theta})\}$: the (laissez-faire) outcome arising under asymmetric information and bail-out, and absent $P$ intervention;

2. $\{E^{s} (\theta), E^* (\bar{\theta})\}$: the (separating) outcome arising under asymmetric information and bail-out, when $P$ implements the mechanism described in Lemma 3;
3. $E^B$: the (bunching) outcome arising under asymmetric information and bail-out, when $P$ implements a unique constraint on $S_2$’s borrowing level.

We proceed by comparing first $\{E^{LF}(\theta), E^*(\bar{\theta})\}$ to $\{E^*(\theta), E^*(\bar{\theta})\}$.

**Lemma 4.** The separating mechanism $\{(J^S, B), (\bar{J}^S, \bar{B})\}$ Pareto dominates the laissez-faire outcome in which the $\bar{\theta}$-type of $S_2$ invests $\bar{B}$, and the $\theta$-type of $S_2$ invests $B^{LF}$.

**Proof.** See the Appendix.

In the presence of asymmetric information and bail-out, $S_1$ finds it profitable to compensate the $\bar{\theta}$-type of $S_2$ with a lump-sum amount to induce it to self-select into the efficient level of borrowing. Because (i) total welfare increases and (ii) the separating mechanism is such that both types of $S_2$ are indifferent between the efficient level of borrowing and the decentralized solution, $S_1$ appropriates the efficiency gains created by this type-contingent mechanism. In other words, $S_1$ prefers to pay $S_2$ a certain lump-sum transfer when the latter has a low multiplier of government spending, rather than face an increase in the expected cost of bail-out due to inefficient overborrowing.

Having established that the separating mechanism Pareto dominates the decentralized (laissez-faire) solution, we now compare the separating solution $\{E^*(\theta), E^*(\bar{\theta})\}$ to the bunching solution $E^B$. 18
Proposition 2. There exists a unique threshold $\alpha^*$ such that, for $\alpha \geq \alpha^*$, the separating mechanism
\[ \{(\tilde{t}^S, \tilde{B}), (\bar{t}^S, \bar{B})\} \] Pareto dominates the bunching rule $B^B(\alpha)$ and the laissez faire solution $(B^{LF}, \bar{B})$.

Proof. See the Appendix.

From Lemma 4, the separating mechanism Pareto dominates the laissez-faire regime. When compared to the bunching rule, the separating mechanism makes both types of $S_2$ better-off. The separating mechanism is costly to $S_1$ because of (i) the transfer ($t$) needed to induce an efficient level of borrowing from the $\theta$-type of $S_2$ and (ii) the associated expected cost of bail-out. The bunching mechanism is also costly to $S_1$, because of the expected cost of bailing $S_2$ out. Because bail-out is only needed for the $\theta$-type of $S_2$, the higher $\alpha$ is, the lower is the probability that $S_1$ bears bail-out costs.

The bunching rule differs from the separating mechanism in one key aspect: the amount of borrowing allowed by the bunching rule increases with the probability ($\alpha$) that $S_2$ is characterized by a high potential output ($\bar{\theta}$). Hence, as $\alpha$ increases, the overborrowing by the $\theta$-type of $S_2$ also increases, and $S_1$ incurs an increasing bail-out cost with a decreasing probability. In the separating mechanism, as $\alpha$ increases, $S_1$ incurs a constant bail-out cost and ex-post transfer with a decreasing probability. The additional effect of $\alpha$ on the amount of bail-out in the bunching rule makes the separating mechanism dominant for sufficiently high values of $\alpha$.

Figure 4 plots $S_1$’s utility from the laissez-faire (black line), bunching (bold red line), and separating solutions (bold black line). Figure 5 plots the utilities the $\theta$-type (Figure 5a) and the $\bar{\theta}$-type (Figure 5b) of $S_2$ obtain from the three alternative solutions.

In Figure 4, $S_1$’s utility from the separating mechanism ($U_{1S}^S$) is higher than its utility from (a) the decentralized solution ($U_{1LF}^S$), $\forall \alpha \in [0, 1]$ (see Lemma 4), and (b) the bunching rule ($U_{1B}^B$), for $\alpha \in [\alpha^*, 1]$ (see Proposition 2). Also, for $\alpha < \tilde{\alpha}$, $S_1$’s utility from the bunching mechanism is higher than its utility from the decentralized mechanism, while the two utilities are the same for $\alpha \geq \tilde{\alpha}$ (see the proof of Proposition 2).

In Figure 5a, the bold black line represents $S_2$’s utility from both the separating and the decentralized mechanism when $S_2$ is characterized by a low potential output (i.e., $U_{2S}^S (\theta) = U_{2LF}^S (\theta)$). The $\theta$-type of $S_2$ obtains a (weakly) lower utility from the bunching mechanism (bold red line) than from the alternative solutions. In Figure 5b, the bold black line represents $S_2$’s utility from both the separating and the decentralized mechanism when $S_2$ is characterized by a high potential output (i.e., $U_{2S}^S (\bar{\theta}) = U_{2LF}^S (\bar{\theta})$). The $\bar{\theta}$-type of $S_2$ obtains a strictly lower utility from the bunching mechanism (bold red line) than from the alternative solutions $\forall \alpha \in [0, 1]$. In Figure 4 and Figure 5, the separating mechanism Pareto dominates both the bunching and the decentralized solutions for $\alpha \geq \alpha^*$.
Figure 4: Country 1’s Utility under the (i) Decentralized, (ii) Bunching, and (iii) Separating Solutions.

Figure 5: Country 2’s Utility under the (i) Decentralized, (ii) Bunching, and (iii) Separating Solutions.

(a) Low Potential Output.

(b) High Potential Output.
To sum up, in the presence of asymmetric information and bail-out, as the prior probability that \( S_2 \)'s type has a high potential output increases, it pays off to both countries to design a mechanism that make each type of \( S_2 \) self-select into its efficient level of borrowing. In fact, both types of \( S_2 \) gain from this mechanism: when characterized by a low potential output, \( S_2 \) is compensated by \( S_1 \) with a transfer for not overborrowing on the financial market. When characterized by a large potential output, \( S_2 \) has access to its efficient level of borrowing. \( S_1 \) also gains from the separating mechanism, because it avoids the inefficiently large costs of bailing \( S_2 \) out implied by a bunching rule.

5 Conclusion

This paper analyzes the main features of a union’s fiscal framework in the presence of (i) asymmetric information over member states’ fundamentals – i.e., potential output and, therefore, output gap – and (ii) bail-out among member states when shocks jeopardize the ability of some members to repay creditors (banks) from other members of the union. In such an environment, optimal counter-cyclical fiscal policies are not incentive-compatible because bail-out incentivizes member states to misrepresent their current output gap and overborrow on the financial market. Moreover, bail-out lowers lenders’ incentives to discriminate among borrowers’ cyclical positions.

Unlike single member states, the union internalizes the externalities and distortions generated by the interplay between asymmetric information and bail-out and designs a mechanism to discriminate borrowers based on the magnitude of their potential output. Such a mechanism implies the payment by the monetary union of a lump-sum transfer to the member state characterized by a low (negative) output gap – and, therefore, a (relatively) small multiplier of government spending – so that each member state self-selects into its efficient level of borrowing. The efficiency gains generated by this separating mechanism makes it Pareto dominant with respect to a decentralized equilibrium in which member states are unconstrained in their borrowing choice. More importantly, provided there is a sufficiently high prior probability that the member state is characterized by a large output gap, the separating mechanism Pareto dominates a bunching rule in which the monetary union sets a unique borrowing constraint. Because the bunching rule is probably the best approximation of the current cyclically-adjusted rule implemented within the European Monetary Union under the Fiscal Compact Treaty, our results can have insightful policy implications.

The fiscal framework currently implemented within the European Monetary Union induces inefficient overborrowing by member states. Many observers note that the future of the European Union’s economic integration relies on its ability to reform this framework, as it has been made evident by the 2012 bail-out of Greece. Our results suggest that, to the extent that asymmetric information on countries’ potential
output cannot be easily eradicated, the European Union would benefit from acknowledging this asymmetric information problem and reforming its fiscal framework. The mechanism proposed in this paper is an attempt to explore the theoretical implications of such a reform. While a full mapping of the mechanism into EU institutions is beyond the scope of our analysis, we envisage, for example, that this mechanism could be implemented by appropriately designing the individual countries’ contributions to, and transfers from, EU permanent funding programmes such as the European Stability Mechanism. We leave an analysis of this and other issues to future research.

References


Appendix

Proof of Proposition 1.

Proof. Given A1-A3, full bail-out implies that both types of $S_2$ have a zero probability of default. The separating offer curves in (16), for $\theta \in \{\bar{\theta}, \bar{\theta}\}$, are both equal to $OC (\bar{\theta})$. This equality further implies that the pooling offer curve in (17) is also given by $OC (\bar{\theta})$. Hence, because there is no cross-subsidization between types, on the one hand the $\bar{\theta}$-type has no incentive to signal its type and invests optimally $B (\bar{\theta}) = B^* (\bar{\theta})$.

On the other hand, because bail-out lowers the $\theta$-type’s probability of default, the $\bar{\theta}$-type chooses:

$$B_{LF}^\theta (\theta, x) = \arg \max_B \left\{ K (\theta, B) \right\} \int_z (Y_2 - z) f (Y_2 | \theta, B) dY_2$$

s.t. $z (x) = B, \quad (32)$

where the constraint represents lenders’ zero profit condition in the presence of full bail-out (A1 and A3).

Therefore:

$$B_{LF}^\theta (\theta, x) = \arg \max_B \left\{ K (\theta, B) \right\} \int_B (Y_2 - B) f (Y_2 | \theta, B) dY_2.$$  \hspace{1cm} (33)

Because $z (\bar{\theta}, x) < z (\bar{\theta}, 0)$ – that is, because bail-out decreases the repayment offered by the $\bar{\theta}$-type of $S_2$ to lenders – we have $B_{LF}^\theta (\bar{\theta}, x) > B^* (\bar{\theta})$. Also, $B_{LF}^\theta (\theta, x) < B^* (\bar{\theta})$ (from $F_{\theta^*} < 0$ in (4)).

Proof of Lemma 1.

Proof. Remember we have defined $U_i^*$ as $S_i$ optimal value function absent bail-out. In the presence of bail-out, from (6) we obtain:
\[ U_1^{LF}(\alpha) = \alpha U_1^* + (1 - \alpha) \left[ U_1^* - \int_0^{z(x, B^{LF})} \min_{\hat{z}(x, B^{LF})} \left[ z(x, B^{LF}) - Y_2, x \right] f(Y_2 | \hat{\theta}, B^{LF}) \, dY_2 \right] \]  \tag{34}

where, from A1 and A3, we have \( z(x, B^{LF}) = B^{LF} \) and where \( S_1 \) optimally chooses \( x \) equal to \( B^{LF} - Y_2 \). We can then write (34) as:

\[ U_1^{LF}(\alpha) = U_1^* - (1 - \alpha) \int_0^{B^{LF}} \left( B^{LF} - Y_2 \right) f(Y_2 | \hat{\theta}, B^{LF}) \, dY_2, \]  \tag{35}

where the RHS in (22) is increasing in \( \alpha \).

Proof of Lemma 2.

Proof. First, it is easily verified that the pair \((t^*, \bar{t}^*)\) verifies (23) as an equality. Second, substituting (25)-(26) in (24), if the left-hand side (LHS) in (25) is greater than zero, we obtain:

\[ \int_{s(\bar{\pi})}^{K(\bar{\pi}, \bar{\theta})} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, \bar{B}) \, dY_2 - \int_{s(\bar{\pi})}^{K(\bar{\pi}, \bar{\theta})} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, \bar{B}) \, dY_2 \geq 0, \]

and

\[ \int_{\bar{\pi}}^{K(\bar{\pi}, \bar{\theta})} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, \bar{B}) \, dY_2 - \int_{\bar{\pi}}^{K(\bar{\pi}, \bar{\theta})} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, \bar{B}) \, dY_2 \geq 0, \]

which holds from (4) (and (19)). If (25) is equal to zero, we obtain:

\[ \int_{\bar{\pi}}^{K(\bar{\pi}, \bar{\theta})} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, \bar{B}) \, dY_2 - \int_{\bar{\pi}}^{K(\bar{\pi}, \bar{\theta})} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, \bar{B}) \, dY_2 \geq 0, \]

which holds by definition of \( \bar{B} \).

Proof of Lemma 3.

Proof. First, from \((t^*, \bar{t}^*)\) in (27) and (28), we have:

\[ U_2^\bar{\pi}(\bar{\theta}) = \bar{t}^* + \int_{\bar{B}}^{K(\bar{\theta}, \bar{B})} (Y_2 - \bar{B}) f(Y_2 | \bar{\theta}, \bar{B}) \, dY_2 = \int_{\bar{B}^{LF}}^{K(\bar{\theta}, B^{LF})} (Y_2 - B^{LF}) f(Y_2 | \bar{\theta}, B^{LF}) \, dY_2 = U_2^{LF}(\bar{\theta}). \]
\[ U_2^g(\bar{\theta}) = \kappa(\bar{\pi}, \bar{B}) \int_{Y_2^{(\bar{\pi})}} (Y_2 - \bar{B}) f(Y_2 | \bar{\pi}, \bar{B}) dY_2 = U_2^{LF}(\bar{\theta}). \]

Second, because \( B^{LF} \) is the level of investment preferred by the \( \bar{\theta} \)-type of \( S_2 \) (under full bail-out), the pair \((\bar{\theta}, \bar{B})\) satisfies (23) as a strict inequality. Finally, substituting (27)-(28) in (24) we obtain:

\[ K(\theta, B) \hat{y}(\theta) \left( Y_2 - B \right) f(Y_2 | \theta, B) dY_2 \geq K(\bar{\theta}, \bar{B}) \hat{y}(\bar{\theta}) \left( Y_2 - \bar{B} \right) f(Y_2 | \bar{\theta}, \bar{B}) dY_2. \]

By adding and subtracting the term

\[ K(\bar{\theta}, B^{LF}) \int_{Y_2^{(\bar{\theta})}} (Y_2 - B^{LF}) f(Y_2 | \bar{\theta}, B^{LF}) dY_2 \]

in LHS in (36), we obtain:

\[ \left[ \int_{Y_2^{(\bar{\pi})}} (Y_2 - \bar{B}) f(Y_2 | \bar{\pi}, \bar{B}) dY_2 - \int_{Y_2^{(\bar{\theta})}} (Y_2 - B^{LF}) f(Y_2 | \bar{\theta}, B^{LF}) dY_2 \right] + \]

\[ \left[ \int_{Y_2^{(\bar{\pi})}} (Y_2 - B^{LF}) f(Y_2 | \bar{\pi}, B^{LF}) dY_2 - \int_{Y_2^{(\bar{\theta})}} (Y_2 - B^{LF}) f(Y_2 | \bar{\theta}, B^{LF}) dY_2 \right] \geq \]

\[ K(\bar{\theta}, B^{LF}) \int_{Y_2^{(\bar{\theta})}} (Y_2 - B^{LF}) f(Y_2 | \bar{\theta}, B^{LF}) dY_2 - \int_{Y_2^{(\bar{\pi})}} (Y_2 - \bar{B}) f(Y_2 | \bar{\pi}, \bar{B}) dY_2, \]

where the first term in square brackets in LHS of (37) is greater than zero, and where – from (4) (and (19)) – the second term in square brackets in LHS of (37) is greater than RHS.

\[ \Box \]

**Proof of Lemma 4.**

Proof. First, by construction, the separating mechanism \((\bar{\theta}, \bar{B}), (\bar{\theta}, \bar{B})\) (weakly) Pareto dominates the decentralized solution for both types of \( S_2 \) (see Lemma 3).
Second, from (6) and (27), and given full-bail out, $S_i$’s expected utility from the separating mechanism is:

$$U^S_i(\alpha) = U^*_i - (1 - \alpha) \left\{ \int_{B^{LF}}^{K(\hat{\theta}, B^{LF})} \left( Y_2 - B^{LF} \right) f \left( Y_2 | \hat{\theta}, B^{LF} \right) dY_2 - \left[ \int_{0}^{K(\hat{\theta}, B)} \int_{Y_2}^{\hat{B}(Y_2 | \hat{\theta}, B) dY_2 - B} \right] \right\}, \quad (38)$$

and $S_i$’s expected utility from the decentralized solution is given by (22), which we report for simplicity:

$$U^{LF}_i(\alpha) = U^*_i - (1 - \alpha) \int_{B^{LF}}^{B^{LF}} \left( B^{LF} - Y_2 \right) f \left( Y_2 | \hat{\theta}, B^{LF} \right) dY_2.$$

From (38) and (22), $S_i$ obtains a higher utility under the separating mechanism than under the decentralized (laissez-faire) regime if:

$$\int_{0}^{K(\hat{\theta}, B)} Y_2 f \left( Y_2 | \hat{\theta}, B^{LF} \right) dY_2 - \bar{B} \geq \int_{0}^{K(\hat{\theta}, B)} Y_2 f \left( Y_2 | \hat{\theta}, B^{LF} \right) dY_2 - B^{LF}, \quad (39)$$

which holds by definition of $B$.

**Proof of Proposition 2.**

*Proof.* Because $B^B(\alpha) \in [\bar{B}, \bar{B}]$ increases in $\alpha$ (see (31)), there exists a unique value $\tilde{\alpha}$ such that $B^B(\tilde{\alpha}) = B^{LF}$, where $B^{LF} > B^B$ (resp., $B^{LF} > B^B$) for $\alpha > \tilde{\alpha}$ (resp., $\alpha < \tilde{\alpha}$).

**Case 1:** $\alpha \geq \tilde{\alpha}$. In this case, the bunching rule $B^B(\alpha)$ is Pareto dominated by the decentralized solution $(B^{LF}, \bar{B})$. In fact, (i) the $\hat{\theta}$—type of $S_2$ is better-off under the decentralized solution because $B^B(\alpha) \geq B^{LF}$, (ii) the $\bar{\theta}$—type of $S_2$ is strictly better-off (resp., indifferent) under the decentralized solution than under the bunching one, for any $\alpha \in [\tilde{\alpha}, 1)$ (resp., for $\alpha = 1$), because it can borrow at the efficient level $\bar{B} \geq B^B$, and (iii) $S_1$ is better-off under the decentralized solution than under the bunching rule, because $\hat{\theta}$—type of $S_2$ borrows $B^{LF} \leq B^B(\alpha)$, which reduces the expected cost of bail-out.\(^24\)

Finally, because the separating mechanism $\{ (\hat{t}^S, \bar{B}), (\hat{t}^S, \bar{B}) \}$ Pareto dominates the decentralized solution (see Lemma 4), the separating mechanism also Pareto dominates the bunching rule $B^B(\alpha)$ when $\alpha \geq \tilde{\alpha}$.

\(^24\)If we were to interpret the borrowing constraint $B^B(\alpha)$ as an upper bound on the level of borrowing rather than as a fixed amount to be borrowed, both $S_1$ and the $\hat{\theta}$—type of $S_2$ would be indifferent between the two regimes.
Case 2: \( \alpha < \tilde{\alpha} \). In this case, both types of \( S_1 \) obtain a higher utility under the separating mechanism than under the bunching rule. By construction, from Lemma 3, under the separating mechanism (i) the \( \theta \)-type obtains the payoff of the decentralized outcome, which dominates the \( \theta \)-type's payoff from the bunching rule as \( B_{LF}^\theta > B_{LF}^\beta \), and (ii) the \( \bar{\theta} \)-type borrows efficiently and obtains the highest possible payoff.

To complete our Pareto analysis, we compare \( S_1 \)'s payoffs under the two rules. Recall that \( S_1 \)'s payoffs from the bunching rule \( U_i^B (\alpha) \) and the separating mechanism \( U_i^S (\alpha) \) are:

\[
U_i^B (\alpha) = U_i^* - (1 - \alpha) \left[ \int_0^{B_i^B (\alpha)} \left( B_i^B (\alpha) - Y_2 \right) f \left( Y_2 \mid \theta, B_i^B (\alpha) \right) dY_2 \right].
\]

Therefore, from (41) and (42), \( U_i^S (\alpha) \geq U_i^B (\alpha) \) if:

\[
\int_{B_i^B (\alpha)} \left( Y_2 - B_i^B (\alpha) \right) f \left( Y_2 \mid \theta, B_i^B (\alpha) \right) dY_2 - \int_0^{B_i^B (\alpha)} Y_2 f \left( Y_2 \mid \theta, B_i^B (\alpha) \right) dY_2 - B_i^B (\alpha) \geq \]

\[
\left[ \int_{B_i^B (\alpha)} \left( Y_2 - B_i^LF (\alpha) \right) f \left( Y_2 \mid \theta, B_i^LF (\alpha) \right) dY_2 - \int_0^{B_i^B (\alpha)} Y_2 f \left( Y_2 \mid \theta, B_i^B (\alpha) \right) dY_2 - B_i^B (\alpha) \right].
\]

By definition of \( B_{LF}^\theta \), we have:

\[
\int_{B_i^LF (\alpha)} \left( Y_2 - B_i^LF (\alpha) \right) f \left( Y_2 \mid \theta, B_i^LF (\alpha) \right) dY_2 \geq \int_{B_i^B (\alpha)} \left( Y_2 - B_i^B (\alpha) \right) f \left( Y_2 \mid \theta, B_i^B (\alpha) \right) dY_2.
\]
where the equality holds for $\alpha = \tilde{\alpha}$. Also, by definition of $B$, we have:

$$
\int_0^{\theta} Y_2 f(Y_2 \mid \theta, B) dY_2 - \left( K\left( \hat{\theta}, B(\alpha) \right) \right) Y^2_2 f(Y_2 \mid \theta, B(\alpha)) dY_2 - B(\alpha),
$$

(45)

where the equality holds for $\alpha = 0$. Hence from (43) and (44)-(45), we have that, for $\alpha = 0$, the inequality in (43) is violated and $U^B_1(0) > U^S_1(0)$. For $\alpha = \tilde{\alpha}$, (43) holds and $U^S_1(\tilde{\alpha}) > U^B_1(\tilde{\alpha})$.

We now show that the left-hand-side (LHS) in (43) is increasing in $\alpha$. The first term of LHS in (43) is increasing in $\alpha$. To prove this statement, note that this term is maximized for $B^B = B^{LF}$, where $B^B(\alpha) \in \left[ B, B^{LF} \right]$ because $\alpha < \tilde{\alpha}$, and where $B^B(\alpha)$ is increasing in $\alpha$. A similar reasoning shows that the second term of the left-hand-side (LHS) in (43) is decreasing in $\alpha$. In fact, this term is maximized for $B^B = B$, where $B^B(\alpha) \in \left[ B, B^{LF} \right]$ because $\alpha < \tilde{\alpha}$, and where $B^B(\alpha)$ is increasing in $\alpha$. We can then conclude that the LHS in (43) is increasing in $\alpha$.

Because the RHS in (43) is independent of $\alpha$, there exists a unique value $\alpha^* \in \left( 0, \tilde{\alpha} \right)$ such that $U^S_1(\alpha^*) = U^B_1(\alpha^*)$, and $U^S_1(\alpha) > U^B_1(\alpha)$ (respectively, $U^S_1(\alpha) < U^B_1(\alpha)$) for $\alpha \in (\alpha^*, \tilde{\alpha})$ (respectively, $\alpha \in \left[ 0, \alpha^* \right]$).

We can finally conclude that, for $\alpha \geq \alpha^*$, the separating mechanism Pareto dominates the bunching rule and the the laissez-faire solution (from Lemma 4). □

Online Supplement (Not for Publication)

The goal of this Supplement is to compare our model to the EMU current fiscal framework and to discuss costs and benefits of targeting cyclically-adjusted variables.

S1. The Policy Background: the EMU Fiscal Framework

The current EMU fiscal framework is defined by the Stability and Growth Pact (SGP), by the Treaty on Stability Coordination and Governance (TSCG) better known as ‘Fiscal Compact’ – and by secondary legislation which defines the implementation process.\(^{25}\) This framework imposes a number of constraints on member states’ fiscal policy aggregates: budget deficit (both nominal and cyclically-adjusted), public debt, and government spending. At the beginning of each year $t$, member states must submit Stability Programmes (SP) reporting the budgetary framework from year $t - 1$ up to year $t + 3$, so that the compliance with the whole above-described set of constraints can be assessed by EU authorities. Macroeconomic and budgetary

\(^{25}\)SGP has been formulated in 1997 (art. 121 of the Treaty on the Functioning of the European Union), implemented in 1999, and modified in 2005 and 2011. TSCG has been signed in 2012 by all the EU member states except Czech Republic and the United Kingdom. Concerning the secondary legislation, see Regulation 1175/2011 and Regulation 1177/2011.
forecasts are made at the national level – either by the government or by independent bodies – but must be compared with those performed by the EU Commission, which ultimately prevail in case of divergences.

Here, we focus only on the cyclically-adjusted flow constraint: each country is required to converge at the Medium Term Objective (MTO), identified as a structural budget deficit – in cyclically-adjusted (CA) terms – net of one-off and other temporary measures, that is:  

$$B_{t}^{CA} = B_{t} + \varepsilon^{DY} \left( Y_{t} - Y_{t}^{*} \right),$$  \hspace{1cm} (46)$$

where $B_{t}$ denotes nominal budget deficit, $Y_{t}$ denotes nominal output, $Y_{t}^{*}$ represents potential output, and $\varepsilon^{DY}$ is the semi-elasticity of the budget deficit (as a ratio to aggregate output) to the business cycle. The semi-elasticity $\varepsilon^{DY}$ measures the automatic non-discretionary change in nominal deficit-to-GDP ratio in response to output gap movements. From (46), $B_{t}^{CA}$ crucially depends on $\varepsilon^{DY}$ and $Y_{t}^{*}$. Although pinning down $\varepsilon^{DY}$ is not without potential ambiguity (see Mourre et al. (2013)), we focus on the estimation of $Y_{t}^{*}$.

In 2002, the EU Council has established that the reference method for the estimation of member states’ potential output is the ‘production function approach’. Potential output is computed on the basis of a standard technology-augmented Cobb-Douglas production function with constant returns to scale on potential capital and labour (Denis et al. (2002), Roeger (2006)). Technology is estimated through a bivariate Kalman Filter that exploits the link between its cyclical component and the degree of capacity utilization as measured by the Capacity Utilization Indicator (for the manufacturing sector) and the Business Survey Capacity Indicator (for the manufacturing sector, the construction sector, and services). Potential capital stock, measured by the perpetual inventory method, corresponds to its actual value, under the assumption of full utilization of the existing stock. The capital is extrapolated in the out-of-sample period according to a given profile of productive investment (estimated through an AR(2) process) and assuming a constant depreciation rate (Cacciotti et al. (2014)). Potential labour is calculated by a Kalman filter estimation of country-specific NAWRU, where the trend component is a random walk with drift, and the cyclical component is given by a Phillips Curve which relates the change in wage inflation to the unemployment rate and other exogenous variables (e.g., terms of trade and wage share). Particularly for the estimation of potential labour, the choice of some parameters (bounds of the shocks to trend, cycle, and Phillips curve’s slope) is crucial in determining the NAWRU and therefore the potential output.

Since 2015, the EU fiscal framework also makes the convergence speed towards the MTO dependent on

\footnote{Examples of temporary measures are sales of non-financial assets, receipts of auctions of public owned licenses, and tax amnesties.}

\footnote{$\varepsilon^{DY}$ is computed as the weighted difference between the elasticities of, respectively, revenue-to-GDP and expenditure-to-GDP to output, where the weights are given by the ten-years moving averages of output shares of revenue and expenditure.}
cyclical conditions (i.e., the magnitude and sign of the output gap) and debt-to-GDP ratio (EU Commission (2015)), thus further strengthening the countercyclical nature of fiscal rules. Through this important modification, the EU Commission further highlights the importance of countries’ cyclical positions for the convergence towards the MTO and the achievements of the fiscal target.

The evaluation of the effectiveness of cyclically-adjusted fiscal rules present both benefits and risks. On the one hand, provided potential output is correctly pinned down, cyclically-adjusted fiscal rules are more suited to identify countries’ true fiscal stance, irrespective of business cycle fluctuations. They also force member states to pursue optimal countercyclical fiscal policies, while providing them with a safety margin (up to the 3% limit) to expand the budget in response to negative output fluctuations, and vice versa (Siu (2004), Andres and Doménech (2006), Manasse (2007)). On the other hand, the main problem with cyclically-adjusted rules is that they require rigorous calculation and estimation of latent variables that are unobservable both ex-ante and ex-post. Particularly, the estimation of potential labour and TFP is extremely sensitive to parameters’ selection, and the complexity of the procedure does not promote full transparency and accountability. Also, the estimation of potential capital stock is troublesome, because it is derived as the sum of past investments that, in turn, are the most cyclical component of aggregate demand (see Cottarelli (2015)); as a consequence, the final estimation might reflect past demand conditions rather than the structural supply features of an economy. Marcellino and Musso (2011) and Tereanu et al. (2014) document that mistakes in fiscal policy prescriptions due to the unreliability of potential output estimation can result in wrong fiscal adjustments, whose size is up to 1.5% of GDP. Masten and Gnip (2016) compare the current EMU methodology to an alternative one derived from a DSGE estimation and find that the former tends to over-estimate the role of discretionary fiscal policy. As a result, policy prescriptions turn out to be wrong.

As described in the introduction, we take the view that potential output is mainly determined by information on which national governments have a comparative advantage with respect to the monetary union decision-making body. Generally speaking, this assumption is supported by the fact that, for instance, national governments know the ‘effectiveness’ of structural investments/reforms within the national territory better than the EU does. Particularly, given the method currently employed by the EMU to compute member states’ potential output, we argue that crucial features of the output gap estimation and, thus, of the country’s cyclical position – such as shocks to Kalman filter’s latent components, which are necessary to initialize the filter and obtain the estimation of potential labour – are better known by member states. Equivalently, given the assumption that spending multipliers are increasing functions of the capacity slack, the information asymmetry can be easily transferred to the magnitude of the government spending multiplier. Both early reduced-form expressions and more recent ones based on deep structural parameters (e.g., Woodford (2012)) highlight that the ex-ante output effect of government spending is determined by parameters on which it
is easy to assume the existence of an information advantage in favour of the member state. Given this information asymmetry, national governments have an incentive to over-estimate their output gap to be allowed a higher nominal deficit (see (46)). In our view, together with the presence of bail-out, this is the source of the problem generated by cyclically-adjusted fiscal rules within a monetary union.

S2. A Comparison with EMU’s Current Fiscal Framework

As discussed in Section 2, the fiscal framework currently implemented within the EMU encompasses a ‘cyclically-adjusted’ cap on member states’ borrowing level. More specifically, from (46), the target imposed on each member state regarding the nominal deficit-to-GDP ratio is adjusted – i.e., relaxed – were the member state to experience a negative output gap. Obviously, the size of the borrowing constraint’s relaxation depends on the member state’s potential output. If lenders expect bail-out to occur among member states, because Excessive Deficit Procedures are initiated only in case a member state overborrows with respect to its cyclically-adjusted cap, each member state has an incentive to misrepresent (upward) its potential output so as to run a higher nominal deficit.

Depending on whether one believes that member states are able to affect EMU’s estimates of their own potential output, the current EMU’s fiscal framework is captured in two different ways. If one believes EMU (possibly partially) bases its fiscal policy on the member state’s estimates of their own potential output, the European fiscal policy is similar to one in which EMU offers member states the possibility to freely choose between different (cyclically-adjusted) deficit-to-GDP thresholds (e.g., $B^*(\theta)$ and $B^*(\bar{\theta})$ in our simplified setting). As shown above, in the presence of bail-out, this system induces member states to run a high deficit-to-GDP ratio, irrespective of their cyclical position. If one believes that EMU only makes use of its own estimates ($\alpha \in [0,1]$) of a member state’s potential output instead, the current European fiscal policy corresponds to one in which $MU$ sets a single bunching borrowing threshold (corresponding to $B^\alpha (\alpha)$ in our setting); in this sense, the bunching threshold is akin to the (country-specific) MTO currently set by EMU. In this second case also, overborrowing occurs when a member state is characterized by a low potential output.

In light of the explanation we put forward in this paper, it is then not surprising that we observe many member states running excessive deficits and, therefore, postponing the achievement of their Medium Term Objective (European Central Bank (2015)).

Provided EMU aims at implementing a cyclically-adjusted mechanism while eliciting member states’ private information, the mechanism proposed in this paper presents one major difference with respect to the current European fiscal framework. To avoid overborrowing when a member state is not far from its potential,
the (relatively) low deficit required from a member state characterized by a (relatively) low potential output must come with an ex-post transfer to be received from the other members of the Union. Possibly, the transfer can be used to increase the member state's potential output. This mechanism has two crucial features: \( i \) it comes from the 'federal' level, therefore it implies a degree of fiscal risk sharing within the Union, and \( ii \) it can be specifically targeted towards goals (possibly jointly determined between the nation state and the monetary union) regarding a permanent increase of a member state's production possibilities.

**Supplementary References**


